Synedrella nodiflora (L.) Gaertn: a review on its phytochemical screening and uses in animal husbandry and medicine

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ABSTRACT

Synedrella nodiflora is from the kingdom of Plantae, subkingdom of Viridiplantae, infrakingdom of Streptophyta, superdivision of Embryophyta, division of Tracheophyta, subdivision of Spermatophytina, class of Magnoliopsida, superorder of Asteranae, order of Asterales, family of Asteraceae, genus of Synedrella Gaertn., and species of *Synedrella nodiflora* (L.) Gaertn. It is found in tropical America, spreading pan-tropically now, throughout the south-east Asian region and some African countries as Benin. It contains several bioactive components such as flavonoids, alkaloids, tannins etc. The methanolic extract of *Synedrella nodiflora* showed the presence of flavonoids, alkaloids, glycosides, steroids, tannins, saponins and phytosterols. The ethanolic extract showed the presence of alkaloids, steroids, gums, reducing sugars and tanins. The aqueous extract contains alkaloids, flavonoids, tannins, saponins, steroids and triterpenoids. The hexane extract showed the presence of flavonoids, steroids, triterpenoids, saponins, alkaloids, phytosterols. The chloroform extract contained flavonoids, steroids, saponins, alkaloids, phytosterols. The acethyl acetate extract revealed the presence of flavonoids, saponins, alkaloids, triterpenoids, phytosterols. The butanol extract showed the presence of flavonoids, steroids, saponins, tannins, alkaloids, glycosides, phytosterols. Benzene and chloroform extracts showed the presence of steroids. *Synedrella nodiflora* leaves are usually eaten as food by livestock and humans without any reported toxicities. Thanks to its sex hormone activity, *Synedrella nodiflora* leaves can be used as Pregnant Mare Serum Gonadotrophin supplier in animal husbandry to improve reproductive parameters in females.

Keywords: *Synedrella nodiflora*, oestradiol, steroïds, animal reproduction, phytochemical screening.

INTRODUCTION

Synedrella nodiflora is an erect branched ephemeral herb usually 30-80 cm tall belonging to family Asteraceae [1]. The shallow root system is usually strongly branched. The erect or ascending, sometimes woody stems, branch dichotomously from the base of the plant; they tend to have long internodes and swollen nodes, to be rounded or slightly angular in section, smooth, often finely hairy, and usually about 50 cm tall. The lower parts of the stems may root at the nodes, especially in damp conditions. The leaves occur in opposite pairs and are 4-9 cm long, elliptic to ovate with three prominent veins and finely toothed margins, finely hairy with short petioles, and joined by a ridge across the stem.

The flowers occur in small crowded bunches of 2-8 inflorescences at nodes and tips throughout the upper third of the plant; each inflorescence consists of several erect bracts 3-5 mm long surrounding 5-6 marginal ray florets and 10-20 central disc florets, each 3-4 mm long with a yellow petal.

The dark brown to blackish (occasionally paler) seeds are dimorphic. Ray floret seeds are flattened, oblong, 3-5 mm long, with upwardly-pointing teeth along the paler marginal wing. Disc floret seeds are thickened, elongate, 3-4 mm long, with 2-4 stiff bristles at the apex. Both types of seed produce identical individuals, which in turn produce both types of seed.

The seedlings have epigeal germination. The hypocotyl is 8-19 mm long, often purplish, and hairless. The cotyledons are elliptic, 6-8 mm long, often reddish or purplish in colour and shortly stalked. The paired juvenile leaves are similar to the adult leaves but smaller.

It is a native to tropical America, but now spreading pan tropically and occurring throughout the south-east Asian region, found in the plains of India, in the Andamans and West Africa. It is also found in Bangladesh, Japan, Spain, China and England.

Different activities are attributed to this vegetal species worldwide [2;3;4]. It contains bioactive components such as flavonoids, alkaloids, tannins etc. and is used for the treatment of various diseases and its leaves are eaten as a vegetable by some livestock and human [5]. The current work aims to review its phytochemical screening and uses in animal husbandry and medicine.

Taxonomy and morphological traits of *Synedrella nodiflora*

Synedrella nodiflora is from the kingdom of Plantae, subkingdom of Viridiplantae, infrakingdom of Streptophyta, superdivision of Embryophyta, division of Tracheophyta, subdivision of Spermatophytina, class of Magnoliopsida, superorder of Asteranae, order of Asterales, family of Asteraceae, genus of Synedrella Gaertn., and species of *Synedrella nodiflora* (L.) Gaertn. [1].

According to [6], *Synedrella nodiflora* is an annual herb. Stem terete, glabrous leaves opposite, petiolate, toothed, ovate to elliptic. Morphologically, this plant is characterized by heads small, heterogamous, rayed; ray florets 1 – 2 seriate, fertile; ligule short, broad, 2- 3 toothed, yellow; disk florets, fertile, tubular, limb 4-toothed. Anthers exerted, epiculate, base subentire. Style exerted; stylar arms are acute and papillate for about half the length. Achenes of ray florets dorsally compressed, 2 winged, smooth, wings lacerate; those of disk florets few, narrower, compressed or triquetrous often muricate, black, ribbed. Anatomically, leaf base shallowly concave on upper side, winged laterally; wings short, ciliate; cilia long.

Epidermis single layered, covered with comparatively thin cuticle. Ground tissue parenchymatous; stomata anomocytic. Trichomes simple as well as glandular. Simple trichomes uniseriate, multicellular, Glandular trichomes with single, short basal cell and unicellular glandular head.

According to [2], the genus *Synedrella* is a monotypic genus, belonging to the tribe *Heliantheae*, and taxonomically close to *Wedelia*. *Synedrella nodiflora* is a highly variable, weedy species. *Synedrella nodiflora* is an erect branched ephemeral herb usually 30-80 cm tall. The shallow root system is usually strongly branched. The erect or ascending, sometimes woody stems, branch dichotomously from the base of the plant; they tend to have long internodes and swollen nodes, to be rounded or slightly angular in section, smooth, often finely hairy, and usually about 50 cm tall. The lower parts of the stems may root at the nodes, especially in damp conditions. The leaves occur in opposite pairs and are 4-9 cm long, elliptic to ovate with three prominent veins and finely toothed margins, finely hairy with short petioles, and joined by a ridge across the stem. The flowers occur in small crowded bunches of 2-8 inflorescences at nodes and tips throughout the upper third of the plant; each inflorescence consists of several erect bracts 3-5 mm long surrounding 5-6 marginal ray florets and 10-20 central disc florets, each 3-4 mm long with a yellow petal. The dark brown to blackish (occasionally paler) seeds are dimorphic. Ray floret seeds are flattened, oblong, 3-5 mm long, with upwardly-pointing teeth along the paler marginal wing. Disc floret seeds are thickened, elongate, 3-4 mm long, with 2-4 stiff bristles at the apex. Both types of seed produce identical individuals, which in turn produce both types of seed [3].

The seedlings have epigeal germination. The hypocotyl is 8-19 mm long, often purplish, and hairless. The cotyledons are elliptic, 6-8 mm long, often reddish or purplish in colour and shortly stalked. The paired juvenile leaves are similar to the adult leaves but smaller. *S. nodiflora* grows in all disturbed tropical and subtropical habitats where there is sufficient soil moisture for its rapid germination, growth, flowering and seed set. It thrives where there is abundant soil and air moisture (but not soil saturation), grows in a very wide range of soils (although it is favoured by high organic content and good fertility), and, because of its very short life cycle, can tolerate most forms of cultivation. Whilst able to grow in full sunlight, this species prefers light or broken shade.

Synedrella nodiflora (L) Gaertn is a small, annual weed of cultivation, native to tropical America, found in the plains of India, in the Andamans and in Africa.

Phytochemical screening of *Synedrella nodiflora*

The presence of various bioactive constituents in the leaf extract of *Synedrella nodiflora* was reported after screening in several studies. The methanolic extract of *Synedrella nodiflora* showed the presence of flavonoids, alkaloids, glycosides, steroids, tannins, saponins and phytosterols. The ethanolic extract showed the presence of alkaloids, steroids, gums, reducing sugars and tanins [4]. The aqueous extract contains alkaloids, flavonoids, tannins, saponins, steroids and triterpenoids. The hexane extract showed the presence of flavonoids, steroids, triterpenoids, saponins, alkaloids, phytosterols. The chloroform extract contained flavonoids, steroids, saponins, alkaloids, phytosterols. The acethyl acetate extract revealed the presence of flavonoids, saponins, alkaloids, triterpenoids, phytosterols. The butanol extract showed the presence of flavonoids, steroids, saponins, tannins, alkaloids, glycosides, phytosterols. Benzene and chloroform extracts showed the presence of steroids. Petroleum ether (40°C - 60°C) extracts showed the presence of steroids and triterpenoids [7].

The study of [3] on the phytochemical screening of *S. nodiflora* reveals also that upon steam distillation of the leaves, *Synedrella nodiflora* yields a yellow colored essential oil (0.02%), with the terpenes 'beta'-caryophyllene, 'beta'-farnesene, germacrene-D and 'beta'-cubebene as major components. From the ethanol extract of the whole plant, the triterpenoid saponin nodifloside A (oleanolic acid3-O-'beta'-D-xylopyranosyl-'beta'-D-glucopyranuronosyl methylate) was isolated, together with the triterpenoid oleanic acid-3-O-'beta'-D-glucopyranuronosyl methylate, and the steroids 'beta'-sitosterol, stigmasterol, stigmasterol-3-O-'beta'-D-glycoside and rosasterol.

Overall, *Synedrella nodiflora* contains a high content of estradiol [3]. Since 1978, [8] have cited *Synedrella nodiflora* in the 4 main sex hormones plants (*Synedrella Nodiflora, Heliotropicum indicum, Belva chal and Phyllanthus neruri*) of Bangladeshi after his preliminary study on sex hormones of medical importance in Bangladeshi plants.

Synedrella nodiflora uses in animal husbandry

Synedrella nodiflora leaves are usually eaten as food by livestock and humans without any reported toxicities [5]. Horses, cattle, pigs and rabbits eat the plant readily [2]. In Benin (West Afriaca), [9] had investigated on the sex hormone activity of this plant in rabbit does. These authors had used *Synedrella nodiflora* leaves as feed supplement in rabbits of the experimental group while the control group had receive only the basic commercial feeds without any plant leaves supplement. It comes out from their study that *Synedrella nodiflora* improves fertility rate and litter size, and reduces significantly the mortality rate from birth to weaning. In further study, [10], had shown that as found for Gonaser, the main effect of leaves of *S. nodiflora* is to increase litter size and to reduce kidding interval. *Synedrella nodiflora* leaves can therefore be used as Pregnant Mare Serum Gonadotrophin supplier in family rabbit breeding to improve reproductive parameters in rabbit does. This variation of the fertility rate found in their study could be related to the sex hormones content of the plant notably its estradiol content [8; 3]. According to [11], prepubertal ovaries also respond when transplanted to mature animals and injecting oestradiol results in LH release in calves as young as 3 months old. The possible causes of sexual maturation at puberty appear to be an increase in pituitary hormones output culminating in increased size and activity of the ovaries and maturation of the hypothalamo-pituitary axis, resulting in secretion of gonadotrophins. Therefore, the highest fertility rate and litter size found in the current study in the rabbit suggested to *Synedrella nodiflora (L.) Gaertn* leaves used as feed supplement in the diet may be related to the hormonal profile of the plant. It's therefore necessary to evaluate the hormonal activity of *Synedrella nodiflora (L.)* Gaertn in other species for better judgment.

In Democratic Republic of Congo, *Synedrella nodiflora* was also used in Guinea pig feeding by [12] during the study on Voluntary intake, chemical composition and in vitro digestibility of fresh forages fed to Guinea pigs in periurban rearing systems of Kinshasa (Democratic Republic of Congo). It appeared from their study that the forages ranking based on the DVI was correlated to the NDF content, but not to their nutritional values determined in vitro. The daily intake of *Synedrella nodiflora* leaves was of 5.94 g DM/ kg liveweight. The contents *of Synedrella nodiflora* forage in dry matter, crude protein, crude fibre, Ash, neutral detergent fibre, acid detergent fibre and acid detergent lignin were respectively 180 g kg^{-1}, 207 g kg^{-1}, 230 g kg^{-1}, 157 g kg^{-1}, 376 g kg^{-1}, 325 g kg^{-1} and 167 g kg^{-1} [12].

The effect of dietary supplementation using node weed (*Synedrella nodiflora*) on the toxicity induced by single or combined doses of copper and lead in the guinea pig (*Cavia porcellus*) was investigated by [13]. Cu 1500 mg kg^{-1} and Pb 600 mg kg^{-1} were given orally as Cu (II)

sulphate and Pb acetate. Single and combined doses of these metals were fed to animal groups with diet supplemented with node weed in one set of groups (A, B and C) and the other set of groups (D, E and F) without node weed supplementation. It comes out from their study that behavioural changes were unaltered in both diet groups although mortality rate was higher in the animals lacking node weed supplementation. Haematological changes were significant in both diet groups, however elevated lymphocyte levels were observed in animals with node weed supplemented diet. Histological changes were pronounced in both dietary groups as evidenced by massive lymphocyte infiltration of the liver and kidney which was more severe in the group with supplemented diet.

Synedrella nodiflora uses in medicine

Plant of Asteraceae family consists of herbs which are known to accumulate substantial amount of flavonoids and to display anti-inflammatory, antioxidant, antimicrobial, analgesic and antipyretic properties [14]. The hydro-ethanolic extract of the whole plant had been demonstrated to possess anticonvulsant [15], sedative [16], in vitro antioxidant and free radical scavenging [17] and antinociceptive properties [18].

In Ghana, S. nodiflora (L) Gaertn weed is used for the treatment of epilepsy and pain [19]. They also use the leaves for threatened abortion, hiccup, laxative and as a feed for livestock [20; 21]. Subsistence farmers in Ghana also use the leaves of the plant as post-harvest protectants [22]. In Nigeria, some indigenous tribes traditionally use the whole plant for treating cardiac problems and to stop wound bleeding [19]. In Malaysia and Indonesia, the plant is used for poulticing sore legs, headaches, earaches, stomach aches and rheumatism [23].

According to [24], the methanolic extract of *Synedrella nodiflora* (SN) (Asteraceae) leaves could be used as a potential antidiarrhoeal agent along with its hypoglycemic potentiality. Indeed, at the doses of 200 and 400 mg/kg body weight, [24] showed that the methanolic extract of *Synedrella nodiflora* (SN) (Asteraceae) leaves showed the antidiarrhoeal activity considerably 58.97% and 73.91% inhibition after 4h. Hypoglycemic effect was evaluated in normal and alloxan induced diabetic rat. The intraperitoneal administration of plant extract at a dose of 150 and 300 mg/kg body weight was given to fasting glucose loaded rat with regard to normal control during 1 hr. study period and in alloxan induced (110 mg/kg body weight) diabetic rat in comparison with reference drug Metformin Hydrocloride (100 mg/kg) during 3 days study period. Considerable drop in elevated blood glucose level was observed in the normoglycemic and alloxan induced diabetic rat. At a dose of 150 and 300 mg/kg the extract showed glucose level reduction of 57.87% and 66.83% in alloxan induced rat while 72% was found for Metformin after 3 days.

[25] showed that aqueous extract of *Synedrella nodiflora* had mitostatic activities in rats. Furthermore, Petroleum ether extract of leaves of *Synedrella nodiflora* Linn. produced cerebroprotective effects in global cerebral ischemia in rats as evident from reduction in behavioral score, hyper locomotion and neuronal damage [26].

Toxicity of the plant extract

The effects of a continuous 14-day oral administration of the whole plant extract (100, 300 and 1000 mg/kg) on haematological and serum biochemical parameters were measured by [27] in rats. It comes out from this study that the extract produced no mortality in the rats treated during the study period. The extract also did not significantly affect any of the

haematological and serum biochemical indices measured. Indeed, the oral administration of SNE (100, 300 and 1000 mg/kg) did not produce any observable abnormality in the movement, salivation, mydriasis, respiratory pattern, piloerection, frequency and consistency of stool of the rats in comparison with the vehicle-treated group, in the entire study period. A post-mortem examination of the *Synedrella nodiflora* extract group and vehicle-treated rats revealed no visible abnormal effects in all the major organs observed. This result suggests that a 14-day oral administration of the hydro-ethanolic extract of *Synedrella nodiflora* is relatively safe in Sprague-Dawley male rats. These results confirm earlier reports of extracts from the plant where no toxicity in vertebrates was observed [28; 29]. Moreover, there are reports of the leaves of the plant being eaten as food by livestock and humans without any reported toxicities [5]. Therefore, the extract is safe with its therapeutic doses of 100, 300, and 1000 mg/kg.

However, some authors report that the aqueous extract of the leaves of *Synedrella nodiflora* (L.) Gaertn is toxic [30] or causes cellular degeneration of the seminiferous tubules in Wistar rat at the dose of 100mg/rat [31].

CONCLUSION

Different activities are attributed to *Synedrella nodiflora* species worldwide. It contains bioactive components such as flavonoids, alkaloids, tannins, etc. and is used for the treatment of various diseases and its leaves are eaten as a vegetable by some livestock and human. Thanks to its sex hormone activity, *Synedrella nodiflora* leaves can be used as Pregnant Mare Serum Gonadotrophin supplier in animal husbandry to improve reproductive parameters in females in family rearing system in sub-Saharan Africa.

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